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A REPORT ON PHENOLS IN EASTERN LAKE ERIE, SEPTEMBER 21-OCTOBER 14, 1955

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SUMMARY

This report presents the findings of a survey of the phenol content of waters in the eastern end of Lake Erie and compares the results to a similar survey conducted in 1948-49.

The average phenol concentration was 2.0 ppb for the 381 samples collected during the 1955 survey. This included 51 samples from new points deeper in Lake Erie and not sampled during the 1948-1949 investigation. Considering the 330 samples which were comparable to the earlier study, the average phenol concentration was 2.3 ppb in 1955 as compared with 10.2 ppb in 1948-1949.

When the I.J.C. Objectives for phenol of 2 ppb average and 5 ppb maximum are applied to the waters, 16 per cent of the sampling points did not meet the Objectives for average and 15 per cent did not meet the Objectives for maximum concentration.

GENERAL INFORMATION

Purpose of Survey

This survey was conducted to determine the current concentrations of phenol prevailing in waters of the eastern end of Lake Erie and to obtain information on the sources of the phenol. The survey results will be used to assess progress in pollution abatement by comparison with those obtained in a previous survey in 1948-49.

Dates

The survey was conducted during the period from September 21, 1955 through October 14, 1955.

Organizations and Personnel Participating

The work was undertaken for the International Joint Commission by a field staff of the Sanitary Engineering Center, U. S. Public Health Service. Laboratory space was provided by the Buffalo Sewer Authority, Buffalo, New York. The U. S. Coast Guard furnished a boat for the lake sampling.

Personnel participating in the conduct of this survey, listed by organization represented, are tabulated below:

NEW YORK STATE WATER POLLUTION CONTROL BOARD
- D. B. Stevens, Associate Chemical Engineer

U. S. COAST GUARD
- J. T. Hagglove, Commander, Buffalo Base
- BMC Hibbert, U.S.C.G.
- BM1 Hogen, U.S.C.G.

U. S. PUBLIC HEALTH SERVICE
- Hayse H. Black, In Charge, Industrial Wastes Studies
- H. R. Pahren, Assistant Sanitary Engineer
- C. R. Hirth, Chemist
- M. W. Ruszaj, Chemist
- P. F. Jones, Engineering Aide

SURVEY PROCEDURES

Sampling Points

Sampling ranges and points in the eastern end of Lake Erie are shown in Figure 1. The sampling points were primarily the same as those used in the 1948-49 survey and their designations were the same. In addition, range W-S was continued from Seneca Shoal to the International Boundary, a new range was added from Wanakah to Crystal Beach, and another new range was taken at Sturgeon Point perpendicular to the United States shore. Samples were taken at 100 different sampling points.

Sampling Method and Preservation

Grab samples were taken at the sampling points and, where depths were sufficient, were taken at approximately 6 foot depth. The samples were preserved with copper sulfate at the time of collection.

Analytical Method

Laboratory determinations were made for phenol only. The Gibbs Method with distillation was used. Results less than 2 ppb were reported as zero.

PRESENTATION AND DISCUSSION OF DATA

Phenols in Lake Erie, Vicinity of Buffalo, N.Y.

When the I.J.C. Objectives for phenols of 2 ppb average and 5 ppb maximum are applied to the waters, 16% of the sampling points did not meet the Objectives for average and 15% did not meet the Objectives for maximum concentration.

The New York State Water Pollution Control Board employs a classification system for Lake Erie waters along the shore and in the outer harbor which does not specify a limiting value for phenol. Considering the New York standard for Class A waters (beyond 1000 feet from shore) of 5 ppb

phenol maximum, 4 per cent of the sampling points in the United States failed to meet this specification.

The average phenol concentration was 2.0 ppb for the 381 samples collected during the 1955 survey. This included 51 samples from new points deeper in Lake Erie and not sampled during the 1948-1949 investigation. Considering the 330 samples which were comparable to the earlier study, the average phenol concentration was 2.3 ppb in 1955 as compared with 10.2 ppb in 1948-1949. The highest maximum phenol value in the 1955 survey was found 100 feet out from the mouth of Smokes Creek and was 84.4 ppb. The next highest value of 77.3 ppb was obtained the same day at the mouth of Smokes Creek. A summary of the average analytical results is presented in Table 1 and the data are plotted on a map of the lake in Figure 1.

Of the 100 sampling points, 10 points showed an increase in average phenol concentration over the 1948-49 values. Seven points showed an increase in maximum concentration. The balance of the values were equal or lower in 1955 than during the 1948-49 survey. The largest increase in average concentration was 1.7 ppb while the largest increase in maximum concentration was 5.0 ppb. Both of these increases occurred at a point 4500 feet from the mouth of the drainage ditch along range 2E.

The range of water temperatures was from a high of 29°C. to a low of 16° C. The maximum value occurred at the mouth of Smokes Creek. In 1948-49 the temperature had a range of 2°C. to 30°C.

In the prior survey, the sampling in the lake proper was confined to September and October 1948, and to May, June, and July 1949. In the Buf-

falo Outer Harbor samples were collected as late as December 1948 and as early as April 1949. The lowest temperature recorded for a lake sample itself in 1948-49 was 8°C. and this occurred in early May. However, many of the samples taken had approximately the same or even higher temperatures than the samples taken at the same points in 1955. Therefore, the 1955 results indicate a definite trend toward lower phenol concentrations in the East End of Lake Erie.

Some information on the sources of phenol pollution is shown by the quantities continuously detected at the mouths of Smokes Creek, South Drainage Ditch, Rush Creek and Union Canal. The quantities found at Point Ni-37.7-200 are attributed to the Buffalo River which is located just south of this point. The phenol detected on several occasions at Point FH-100 probably originated at the south end of Buffalo Outer Harbor. In the south half of the harbor there is a definite zone near the east shore which is marked by a visible color and turbidity.

During the 1955 survey, there were only three days when phenol penetrated significant distances into Lake Erie. On September 27 and October 3, the observations appear to be associated with meteorological influences. The phenol results for September 28 cannot be explained.

The local climatological data show winds from the northeast, north, and northwest for the period September 20 to 26, inclusive. Lake surface currents thus induced are believed to be a contributing factor in phenol penetration into Lake Erie. Water samples collected, on September 27, 1955, along range IE, which begins at Smokes Creek, showed:

Distance from U. S. Shore in Feet	Phenol Concentration ppb
0	77
100	84
400	25
2000	5.4
5000	3.6

On this date, the phenol concentration was 9.0 ppb over the Erie County Water Authority intake.

On September 27, the prevailing wind was from the south, and on September 28 from the west. There was 0.49 inch rain the evening of September 27. Samples collected September 28 along range NI 37.7, at the entrance to Niagara River, showed a phenol concentration of 7.2 ppb at a distance 500 feet from the Canadian shore and 9.0 ppb, 3500 feet from the Canadian shore. Samples collected in U.S. waters September 28 along range NI 37.7 all contained less than 2 ppb phenol.

Wind was believed to be a contributing factor for samples collected October 3 when a phenol concentration of 8.6 ppb was found 2000 feet from shore on range 1E and 6.1 ppb at a distance 2500 feet from shore along range 2E. The wind direction was recorded as east southeast on October 2 and from the northeast October 3.

Attention is invited to the fact that a trace of phenol was found 2000 feet from shore on two of three sampling runs on the new range established at Sturgeon Point. Although the phenol concentrations were only 2.5 and 3.1 ppb, the very fact that phenol was present at this point in the lake should be given due consideration.

Phenols in the Main Body of Lake Erie

In the summer of 1955, samples were taken by U. S. and Canadian personnel throughout Lake Erie in conjunction with work being done by the Great Lakes Fisheries Research Group. This group made studies of lake currents, temperatures, and other conditions in the lake water which may affect fish

propagation. Although data along several of the routes are lacking, this was the first known attempt to obtain samples for phenol analysis from the entire lake on the same day. The data obtained are tabulated in Table II. The reasons for the relatively high phenol values in the southwest and southern part of the lake have not been resolved.

Phenolic loads which are discharged to Lake Erie from Ohio industrial establishments are summarized in Table III. This information was compiled by the Ohio State Department of Health in August, 1955.

TABLE I

SUMMARY OF AVERAGE ANALYTICAL RESULTS

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
	0		U. S. Shore	
BA. A range in Buffalo Harbor from the United States Coast Guard slip to the breakwater	100	Average	0.8	2
		Maximum	3.1	10
		Minimum	0	0
		No.of Samples	4	24
	700	Average	1.3	2
		Maximum	2.5	14
		Minimum	0	0
		No.of Samples	4	26
	1500	Average	0.6	1
		Maximum	2.5	8
		Minimum	0	0
		No.of Samples	4	24
	0		U. S. Shore	
FH. A range in Buffalo Harbor from the north end of the Ford Co. dock to the breakwater	100	Average	3.4	5
		Maximum	7.8	25
		Minimum	0	0
		No.of Samples	4	16
	700	Average	0	4
		Maximum	0	30
		Minimum	0	0
		No.of Samples	4	18
	1500	Average	0.6	4
		Maximum	2.4	25
		Minimum	0	0
		No.of Samples	4	16
	0		U. S. Shore	
UL. A range in Buffalo Harbor from the mouth of Union Canal through south entrance to a point 300 feet west of South Pier Light	100	Average	13.0	27
		Maximum	20.1	90
		Minimum	6.9	0
		No.of Samples	4	23
	300	Average	6.9	30
		Maximum	10.2	110
		Minimum	4.4	0
		No.of Samples	4	16

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
UL. (Continued)	1,000	Average	4.1	49
		Maximum	8.7	200
		Minimum	0	0
		No.of Samples	4	23
	2,000	Average	1.6	3
		Maximum	3.7	25
		Minimum	0	0
		No.of Samples	4	23
	3,000	Average	0.6	2
		Maximum	2.5	15
		Minimum	0	0
		No.of Samples	4	18
	4,000	Average	1.4	1
		Maximum	3.1	12
		Minimum	0	0
		No.of Samples	4	22
	Miles		South Pier Light	
	0			
LW. A range south from South Pier Light over the Erie County Water Authority intake, to point W,1-1/2 miles south of the intake	0.5	Average	0	1
		Maximum	0	3
		Minimum	0	0
		No.of Samples	4	5
	1.5	Average	0	1
		Maximum	0	6
		Minimum	0	0
		No.of Samples	4	5
	2.0	Average	2.4	1
		Maximum	4.9	4
		Minimum	0	0
		No.of Samples	4	5
	2.5 (Intake)	Average	2.3	2
		Maximum	6.0	4
		Minimum	0	0
		No.of Samples	4	5
	3.0	Average	0	2
		Maximum	0	6
		Minimum	0	0
		No.of Samples	4	5

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Miles)		Phenols ppb 1955	Phenols ppb 1948-49
1W. (Continued)	4.0		Point W	
	4.0	Average	0.8	1
		Maximum	3.1	4
		Minimum	0	0
		No.of Samples	4	5
	Feet			
	0		U. S. Shore	
1E. A range from the south of Saukee Creek, perpendicular to the U.S.Shore	0	Average	41.8	98
		Maximum	-	220
		Minimum	0	10
		No.of Samples	4	7
	100	Average	22.2	50
		Maximum	84.4	110
		Minimum	0	Trace
		No.of Samples	4	3
	400	Average	8.9	62
		Maximum	24.6	148
		Minimum	0	3
		No.of Samples	4	6
	2,000	Average	3.5	39
		Maximum	8.6	148
		Minimum	0	0
		No.of Samples	4	6
	5,000	Average	1.5	2
		Maximum	3.6	6
		Minimum	0	0
		No.of Samples	4	5
	0		U. S. Shore	
2E. A range from the south of drainage ditch at south boundary of Bethlehem Steel property, perpendicular to U.S.Shore	0	Average	27.9	74
		Maximum	39.0	150
		Minimum	12.3	3
		No.of Samples	5	8
	400	Average	0.9	26
		Maximum	3.7	112
		Minimum	0	0
		No.of Samples	4	6

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
2E. (Continued)	2,500	Average	2.6	12
		Maximum	6.1	45
		Minimum	0	0
		No.of Samples	4	5
	4,500	Average	2.7	1
		Maximum	9.0	4
		Minimum	0	0
		No.of Samples	4	6
	0		U. S. Shore	
3E. A range from the mouth of Rush Creek perpendicular to U.S. Shore	0	Average	12.9	48
		Maximum	28.9	128
		Minimum	0	4
		No.of Samples	4	7
	400	Average	1.5	1
		Maximum	3.7	4
		Minimum	0	0
		No.of Samples	4	4
	2,000	Average	0.9	7
		Maximum	3.7	20
		Minimum	0	0
		No.of Samples	4	5
	0		U. S. Shore	
4E. A range from the Wanakah Water Company perpendicular to U.S. Shore	325	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	2
	2,000	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	2
	0		U. S. Shore	
5E. A range from Sturgeon Point west of the breakwall perpendicular to U. S. Shore	200	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	2,000	Average	1.9	-
		Maximum	3.1	-
		Minimum	0	-
		No.of Samples	3	-

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
5E. (Continued)	3,000	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	4,000	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	5,000	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	10,000	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	0		Canadian Shore	
1W. A range from Rose Hill Point, perpendicular to Canadian Shore	200	Average	0	6
		Maximum	0	25
		Minimum	0	0
		No.of Samples	4	4
	600	Average	0	1
		Maximum	0	3
		Minimum	0	0
		No.of Samples	4	6
	1,000	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	6
	1,500	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	6
	2,000	Average	0	1
		Maximum	0	3
		Minimum	0	0
		No.of Samples	4	6

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
1W. (Continued)	2,500	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	5
	0		Canadian Shore	
2W. A range from Windmill Point perpendicular to Canadian Shore	200	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	6
	600	Average	0	0
		Maximum	0	3
		Minimum	0	0
		No.of Samples	4	8
	1,000	Average	0	3
		Maximum	0	20
		Minimum	0	0
		No.of Samples	4	8
	1,500	Average	0	2
		Maximum	0	8
		Minimum	0	0
		No.of Samples	4	8
	2,000	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	8
	2,500	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	5
	0		Canadian Shore	
3W. A range from Crystal Beach Pier perpendicular to Canadian Shore	200	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	7
	600	Average	1.4	0
		Maximum	3.1	3
		Minimum	0	0
		No.of Samples	4	8

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
3W. (Continued)	1,000	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	8
	1,500	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	8
	2,000	Average	0	1
		Maximum	0	5
		Minimum	0	0
		No.of Samples	4	7
	2,500	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	5
	Miles			
	0		U. S. Shore	
P-1W. A range from point "P" on the United States shore through Seneca Shoal light to Rose Hill Point, Ontario(1W)	1.0	Average	1.2	0
		Maximum	3.5	0
		Minimum	0	0
		No.of Samples	3	4
	2.0	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	3	4
	3.0	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	3	5
	3.5	Seneca Shoal		
	4.0	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	3	5

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Miles)		Phenols ppb 1955	Phenols ppb 1948-49
P-1W. (Continued)	5.0	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	4	5
	5.8	International Boundary		
	6.0	Average	0	0
		Maximum	0	0
		Minimum	0	0
		No.of Samples	3	6
	7.0	Average	0	1
		Maximum	0	6
		Minimum	0	0
		No.of Samples	3	6
	8.0	Average	0	1
		Maximum	0	6
		Minimum	0	0
		No.of Samples	3	7
	9.0	Average	0	2
		Maximum	0	7
		Minimum	0	0
		No.of Samples	3	6
	0		U. S. Shore	
	0.4	Point W		
W-S-D. A range from point "W" through Seneca Shoal to the International Boundary	1.4	Average	0.5	39
		Maximum	2.0	160
		Minimum	0	0
		No.of Samples	4	5
	2.4	Average	0	9
		Maximum	0	45
		Minimum	0	0
		No.of Samples	4	5
	3.4	Average	0.6	28
		Maximum	2.5	140
		Minimum	0	0
		No.of Samples	4	5

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Miles)		Phenols ppb 1955	Phenols ppb 1948-49
W-S-D. (Continued)	3.8	Seneca Shoal		
	4.4	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	4	-
	5.4	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	4	-
	6.4	Average	0.6	-
		Maximum	2.5	-
		Minimum	0	-
		No.of Samples	4	-
	0	South Pier Light		
LC. A range from South Pier Light to Crystal Beach, Ontario, thence along beach for 1-1/2 miles on a line about 1000 feet from shore	0.5	Average	0.8	2
		Maximum	3.3	10
		Minimum	0	0
		No.of Samples	4	11
	1.0	Average	0.6	2
		Maximum	2.3	7
		Minimum	0	Trace
		No.of Samples	4	3
	2.0	Average	0	1
		Maximum	0	4
		Minimum	0	0
		No.of Samples	4	10
	2.8	International Boundary		
	3.0	Average	0.6	Trace
		Maximum	2.3	Trace
		Minimum	0	0
		No.of Samples	4	5
	4.0	Average	0.8	1
		Maximum	3.3	3
		Minimum	0	0
		No.of Samples	4	8

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Miles)		Phenols ppb 1955	Phenols ppb 1948-49
LC. (Continued)	6.0	Average	0	2
		Maximum	0	6
		Minimum	0	0
		No.of Samples	4	8
	7.0	Average	0	Trace
		Maximum	0	Trace
		Minimum	0	0
		No.of Samples	4	2
	8.0	Average	0.6	1
		Maximum	2.3	4
		Minimum	0	0
		No.of Samples	4	7
	8.5	Average	0	Trace
		Maximum	0	Trace
		Minimum	0	0
		No.of Samples	4	2
	9.0	Average	0	5
		Maximum	0	16
		Minimum	0	0
		No.of Samples	4	8
	9.5	Junction with Range 3W		
	9.5	Average	0	2
		Maximum	0	8
		Minimum	0	0
		No.of Samples	4	6
	10.0	Average	0	12
		Maximum	0	55
		Minimum	0	0
		No.of Samples	4	6
	10.5(c)	Average	1.2	71
		Maximum	2.4	400
		Minimum	0	0
		No.of Samples	4	6

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Miles)		Phenols ppb 1955	Phenols ppb 1948-49
	0		U. S. Shore	
PC. A range from point "P" on the U.S.Shore to point "C" in Crystal Beach Bay	1.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	2.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	3.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	5.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	8.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	10.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	11.0	Average	0	-
		Maximum	0	-
		Minimum	0	-
		No.of Samples	3	-
	12.0	Point C		

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
	0		U. S. Shore	
Mi-37.7. A range across the river just below the confluence of the Buffalo and Niagara Rivers and Buffalo Harbor and in line with the City of Buffalo water intake	200	Average	2.0	40
		Maximum	4.9	450
		Minimum	0	0
		No.of Samples	5	40
	1,000	Average	0.5	25
		Maximum	2.5	500
		Minimum	0	0
		No.of Samples	5	33
	2,000	Average	0.6	1
		Maximum	2.5	20
		Minimum	0	0
		No.of Samples	4	39
	3,500	Average	0	1
		Maximum	0	4
		Minimum	0	0
		No.of Samples	4	34
	5,500	Average	0	1
		Maximum	0	6
		Minimum	0	0
		No.of Samples	4	25
	6,500	Water Intake-City of Buffalo, N.Y.		
	6,500	Average	0	1
		Maximum	0	14
		Minimum	0	0
		No.of Samples	4	31
	8,000	International Boundary		
	8,500	Average	2.2	1
		Maximum	9.0	10
		Minimum	0	0
		No.of Samples	4	31
	10,000	Average	0	2
		Maximum	0	14
		Minimum	0	0
		No.of Samples	4	24

SUMMARY OF AVERAGE ANALYTICAL RESULTS Cont'd

Sampling Range and Location	Station (Feet)		Phenols ppb 1955	Phenols ppb 1948-49
MI-27.7. (Continued)	11,500	Average	2.6	2
		Maximum	7.2	25
		Minimum	0	0
		No.of Samples	4	31
	12,000	Canadian Shore		

TABLE II.

AVERAGE OF PHENOL SAMPLES TAKEN IN THE MAIN BODY OF LAKE ERIE

Route **	General Location of Area	Phenol ppb	No. of Samples
A	Southwest end of Lake Erie to Bass Islands	32	7
B	Area around Pelee Island	25	9
C	Cedar Point to Avon Point in south half of lake	56	7
D	Fairport to Cleveland in south half to lake	23	9
E	Ashtabula to Conneaut in south half of lake	-	0
F	Conneaut to Westfield, N.Y. and as far north as Long Point	-	0
G	Entire lake east of Silver Creek, N.Y.	<5	9
H *	Northwest end of lake to Pelee Point	4	10
I *	Pelee Point to Erieau in north half of lake	2	7
J	Erieau to Port Stanley in center of lake	-	0
K	Port Stanley to Clear Creek in north half of lake	2	2
L *	Long Point to Port Maitland in north half of lake	4	9
M	Port Maitland to Port Colborne and as far south as Dunkirk	2	6

* On routes H, I and L the average represents samples from 8/2/55 and 8/30/55 work. The balance of the values shown are from 8/2/55 sampling only.

** See map on Figure 2.

TABLE III.

SUMMARY OF PHENOLIC LOADS DISCHARGED TO LAKE ERIE
FROM OHIO INDUSTRIAL ESTABLISHMENTS

Toledo Area (Maumee River & Maumee Bay)	Phenol Disch.(a)
1 - by-product coke plant - 1800 T. per day coke production	1161 lbs. per 24 hrs.
3 - oil refineries - 154,000 bbl. per day crude oil processed	1614 lbs. per 24 hrs.
One 54,000 bbl. refinery (b)	
One 60,000 bbl. refinery	
One 40,000 bbl. refinery	
Total	2775 lbs. per 24 hrs.

Note: (a) Phenolic loads calculated from data submitted in monthly reports of operation-average loads over period of 12 months ending May 1955.

(b) Two refineries served by common industrial wastes treatment and disposal facilities (capacities 25,000 & 29,000 bbls., respectively).

Lorain Area (Black River)	Phenol Disch.(a)
1 - by-product coke plant - 6750 T. per day coke production	100 lbs. per 24 hrs.

Note: (a) Dephenolizing facilities provided - phenol discharged represents company estimate of content of outfall sewer based on limited analyses.

Cleveland Area (Lower Cuyahoga River)	Phenol Disch.(b)
1 - by-product coke plant(a) - 1585 T. per day coke produced (nominal capacity)	354 lbs. per 24 hrs.
1 - by-product coke plant(a) - 5300 T. per day coke produced (nominal capacity)	1060 lbs. per 24 hrs.
1 - oil refinery - 50,000 bbl. per day crude oil processed	41 lbs. per 24 hrs.
2 - tar refining plants	30 lbs. per 24 hrs.
Total	1485 lbs. per 24 hrs.

Note: (a) Quenching of coke with ammonia still wastes and other phenol bearing waste increments practiced.

(b) Phenolic loads calculated from data submitted in monthly operation reports received during 12-month period ending April 1955.

TABLE III (Continued)

SUMMARY OF PHENOLIC LOADS DISCHARGED TO LAKE ERIE
FROM OHIO INDUSTRIAL ESTABLISHMENTS

1 - by-product coke plant, down for past year, will be reactivated about Sept. or Oct. 1955. Nominal capacity approximately 1360 T. per day coke production.

Painesville Area (Lake Erie)	Phenol Disch.(a)
1 - by-product coke plant - 420 T. per day coke production	230 lbs. per 24 hrs.

Note: (a) Estimated.

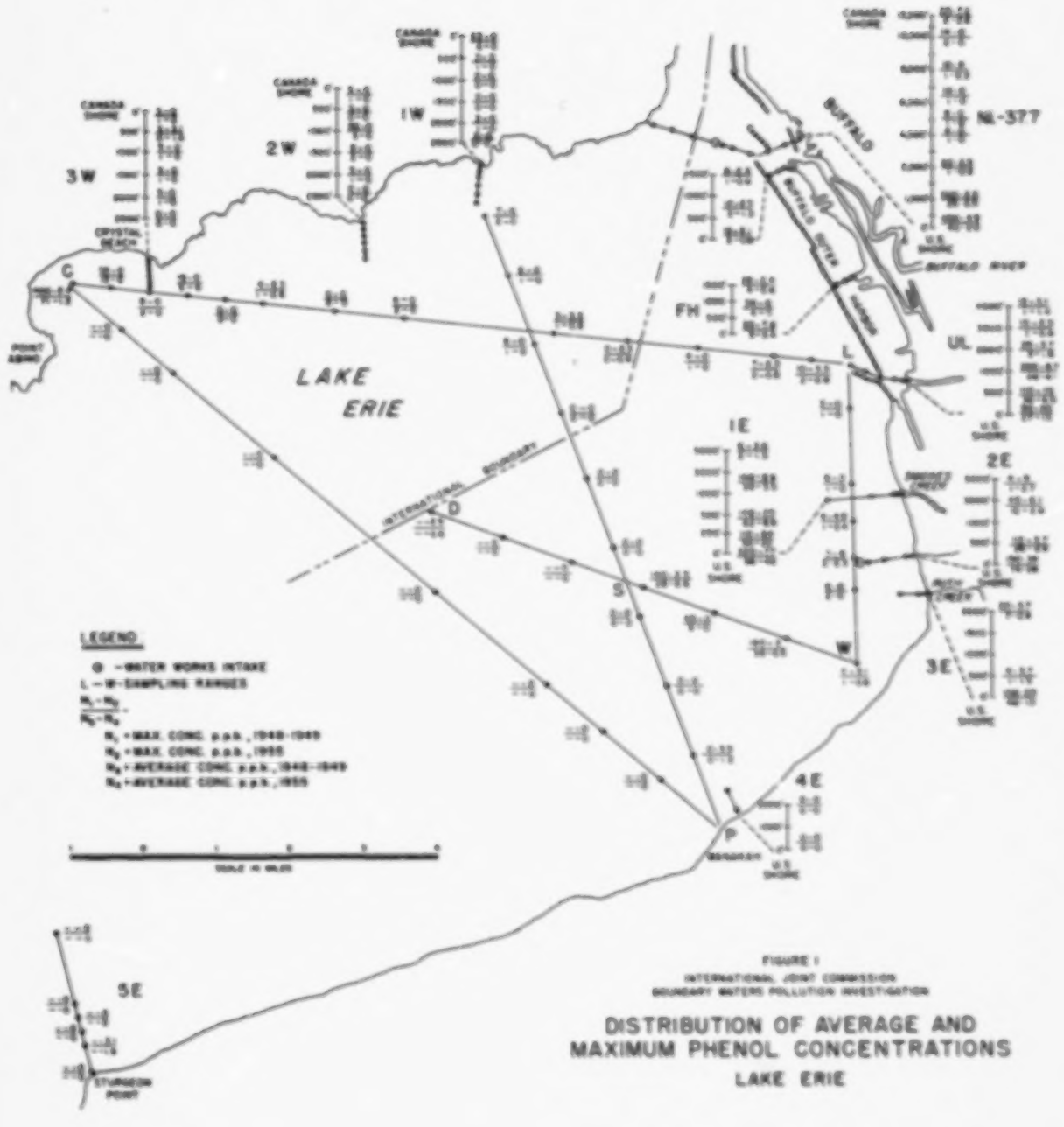

FIGURE I
INTERNATIONAL JOINT COMMISSION
BOUNDARY WATERS POLLUTION INVESTIGATION

DISTRIBUTION OF AVERAGE AND MAXIMUM PHENOL CONCENTRATIONS
LAKE ERIE

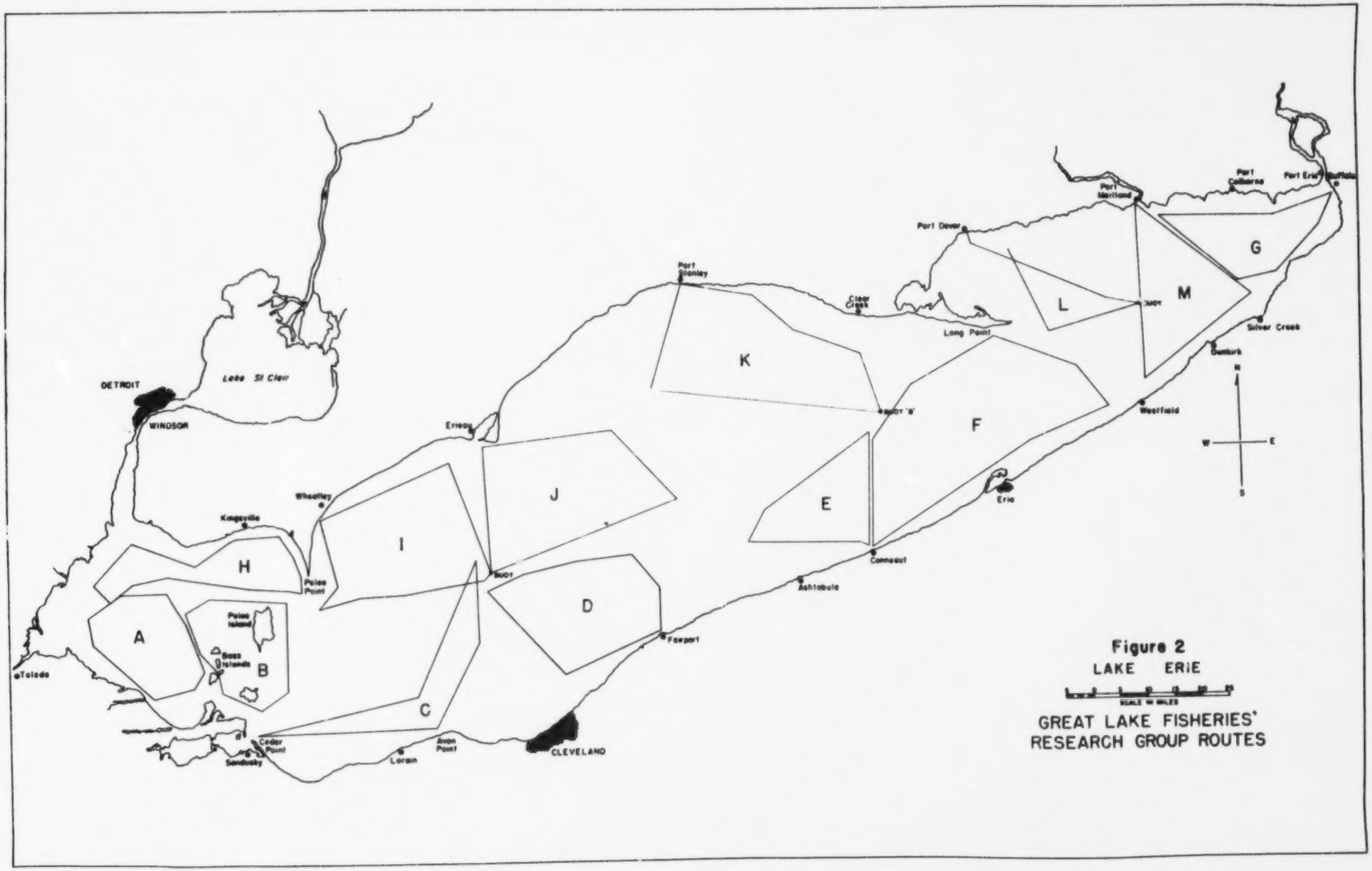

Figure 2

LAKE ERIE

GREAT LAKE FISHERIES' RESEARCH GROUP ROUTES